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Daily Values of Potential Transpiration

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Monthly estimates of potential transpiration can readily be made by methods based on the classic Penman approach. It is necessary at times to estimate potential transpiration for intervals shorter than a month and although the Penman method may be used, with decreasing confidence, for intervals down to about seven days, for periods of less than a week it is necessary to resort to an indirect method of apportioning the total transpiration to individual days.

One approach is to sub-divide the transpiration according to the ratio of daily sunshine to total sunshine for the period but, when individual days are being considered, the problem of transpiration on sunless days arises.

Examination of 20 years (1953-72) radiation data for Kew shows that the average amount of global radiation which falls on sunless days, expressed as a percentage of the monthly total is:-

J	F	M	A	M	J	J	A	S	O	N	D
1.6	1.6	1.2	1.2	1.0	1.0	1.1	1.0	1.2	1.2	1.4	1.8

If this proportion of the total transpiration is allocated to each day as a "background field" for diffuse radiation then the remaining transpiration may be apportioned according to the ratio of daily to total sunshine.

For practical purposes it is suggested that the percentages used for sunless conditions be:-

April to September	1.0% per day
January and December	1.7% per day
February and November	1.5% per day
March and October	1.2% per day

Values of daily transpiration derived by this method for Terrington St Clement for April to September 1973 are given in the appendix to this memorandum.

There are, of course, a number of sources of error which must be considered when using data derived in this way.

1. There is a large day to day variation in radiation under sunless conditions depending on whether the day is perhaps one of continuous rain from complete overcast or a fairly bright day with complete cover of thin upper cloud.

2. The sunless day allocation will depend on the character of the month i.e. by using a percentage of the total a sunless day in a predominantly sunny month will be credited with more transpiration than one in a dull month when the total transpiration will be lower.

3. For the same reasons a day of say 10 hours sunshine will be credited with more transpiration in a sunny month than in a dull one.

4. For a day with less than maximum possible sunshine, the transpiration will depend on the time on which the sunshine occurs - i.e. 6 hours sunshine centered around midday should provide more transpiration than 3 hours early morning plus 3 hours late evening.

5. No attempt has been made to adjust for the seasonal march of transpiration which should, for example, give more transpiration per hour of sunshine at the end of April than at the beginning of the month. This amount of change will vary from month to month but will be small when dealing with weekly rather than monthly periods.

6. Coastal effects, e.g. position of cloud banks relative to the station, and pollution concentrations may affect the relationship between sunshine and global radiation in some areas.

Despite these reservations, however, it is considered that this method can provide realistic short period estimates of transpiration when summed over say 5 to 7 days; individual daily estimates will be an improvement on using a simple proportion of a monthly total even where this is adjusted for average seasonal march of transpiration.

Any comments or suggestions on this paper should be referred to the author.

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Appendix

Estimated daily values of potential transpiration at Terrington St Clement, April to September 1973.

	APR		MAY		JUN		JUL		AUG		SEP	
Day	Sun	PT (mm)	Sun	PT (mm)	Sun	PT (mm)	Sun	PT (mm)	Sun	PT (mm)	Sun	PT (mm)
1	0.2	0.6	12.4	4.5	8.7	3.6	8.2	4.3	8.1	3.4	1.0	0.8
2	0.3	0.6	12.0	4.4	7.8	3.4	9.6	4.9	8.6	3.5	7.7	2.4
3	8.5	2.6	0.0	0.8	11.6	4.5	11.8	5.8	4.0	2.1	2.1	1.0
4	0.0	0.6	8.6	3.4	7.4	3.2	10.8	5.4	6.6	2.9	9.8	2.9
5	5.4	1.9	0.5	1.0	13.5	5.1	12.4	6.0	1.5	1.3	7.9	2.4
6	7.4	2.4	0.6	1.0	11.6	4.5	1.3	1.4	3.0	1.8	5.9	1.9
7	9.5	2.9	9.6	3.7	12.8	4.8	1.5	1.5	7.6	3.2	8.9	2.7
8	5.9	2.0	0.4	0.9	9.5	3.9	8.5	4.4	6.1	2.7	9.3	2.7
9	9.6	2.9	1.4	1.2	6.2	2.9	9.1	4.7	6.5	2.9	7.4	2.3
10	10.3	3.1	12.0	4.4	0.2	1.1	0.2	0.9	6.0	2.7	5.4	1.8
11	5.3	1.9	10.2	3.9	7.5	3.3	1.2	1.3	8.8	3.6	9.3	2.7
12	4.6	1.7	9.7	3.7	8.8	3.7	7.5	4.0	8.9	3.6	10.7	3.1
13	2.9	1.3	0.9	1.1	12.3	4.7	0.2	0.9	11.8	4.5	0.3	0.6
14	2.1	1.1	12.7	4.6	12.7	4.8	4.7	2.8	11.5	4.5	10.8	3.1
15	4.4	1.6	7.3	3.0	12.1	4.6	0.8	1.2	10.3	4.1	6.5	2.1
16	2.4	1.1	14.0	5.0	8.7	3.6	2.0	1.7	9.7	3.9	2.3	1.1
17	5.6	1.9	10.5	3.9	6.6	3.0	2.4	1.9	1.1	1.2	0.7	0.7
18	0.2	0.6	5.0	2.3	12.2	4.7	0.3	1.0	8.6	3.5	7.3	2.3
19	7.4	2.4	4.2	2.1	3.3	2.0	0.8	1.2	2.9	1.7	1.2	0.8
20	3.2	1.3	4.4	2.1	0.0	1.1	3.8	2.4	0.1	0.9	4.5	1.6
21	5.2	1.8	2.5	1.6	11.8	4.5	2.6	1.9	0.0	0.8	0.0	0.5
22	7.7	2.4	7.8	3.1	12.3	4.7	3.6	2.3	10.0	4.0	7.4	2.3
23	2.4	1.1	0.4	0.9	11.5	4.5	1.9	1.6	11.7	4.5	3.2	1.3
24	11.8	3.4	2.7	1.6	10.8	4.3	5.6	3.2	9.7	3.9	5.3	1.8
25	12.5	3.6	11.5	4.2	4.1	2.3	5.5	3.1	5.1	2.4	7.3	2.3
26	5.8	2.0	11.6	4.3	2.7	1.9	2.7	2.0	5.5	2.6	0.0	0.5
27	6.6	2.2	10.1	3.8	0.9	1.3	2.0	1.7	4.6	2.3	4.5	1.6
28	5.6	1.9	1.5	1.3	2.3	1.7	0.0	0.9	0.4	1.0	3.6	1.4
29	7.4	2.4	1.7	1.3	7.3	3.2	0.4	1.0	0.0	0.8	7.5	2.3
30	0.0	0.6	5.2	2.4	11.6	4.5	7.6	4.0	4.4	2.2	3.8	1.4
31			0.0	0.8			11.6	5.7	0.6	1.0		
Total	160.2	55.9	191.4	82.3	248.8	105.4	140.6	85.1	183.7	83.5	161.6	54.4